

APPLICATION FOR
UNITED STATES LETTERS PATENT

FOR
METHOD AND SYSTEM FOR PROVIDING AN INTEGRATED FUNCTIONAL
TOPOLOGY FOR WIRELESS AND WIRELINE COMMUNICATION NETWORKS

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RELATED APPLICATIONS

sub a' \ The present application is related to the subject matter of the following applications. serial no. 09/_____ (Docket No. RR2510) entitled "Method and Apparatus for Providing a Mobile Switching Center Intranet Function" and filed _____, 1999; serial no. 09/_____ (Docket No. RR2341) entitled "Method and System for Providing an Integrated Functional Topology for Wireless and Wireline Communication Networks" and filed _____, 1999; serial no. 09/_____ (Docket No. RR2332) "Integration of ATM Edge Switch with Access Device" and filed _____, 1999; serial no. 09/_____ (Docket No. RR2344) "Method and System for Next Generation Wireless Network Access Function". The content of the above-referenced applications is incorporated herein by reference.

BACKGROUND OF THE INVENTION**Technical Field:**

The present invention relates in general to an improved communications system. In particular, the present invention relates to an improved communications system in which landline (wireline) and mobile communication devices are utilized to initiate communication transactions. More particularly, the present invention relates to an improved communications system in which wireless and wireline access infrastructures are fully integrated. Still more particularly, the present invention relates to cellular communication networks that incorporate both wireline and

wireless features.

Description of the Related Art:

Communication networks, such as wireless and wireline telephone systems, are well-known. A typical wireline based communications system utilizes a physical path to transmit signals. Such wireline systems are also referred to as "landline" systems. Examples of wireline communications systems include telephone, telegraph, facsimile, closed circuit television and so forth. Examples of wireless communication systems include cellular telephone systems. A cellular telephone system, in particular, includes cellular subscriber units that can be mobile or portable, and cellular base stations which are connected to the public telephone company via one or more cellular switching networks. Each cellular subscriber has an assigned cellular telephone number which allows the user (i.e., the cellular subscriber) to place and receive calls within a widespread range of the cellular base stations, such as throughout a metropolitan area.

Computerized switching is essential to the operation of both wireline and wireless telephone communication systems. Telephone communication networks typically provide features for redirecting calls on behalf of telephone users. Examples of such features include call forwarding, call transfer, release link trunking, and simultaneous ringing, all well known in the communications arts. Call forwarding, for example, is a network-provided service feature in which calls may be redirected from an originally called address to another address specified by

a call forwarding party.

5 A problem associated with such telephone communication
networks is the inability to successfully integrate
wireless and wireline access infrastructures present
within such communication networks. Presently, wireless
and wireline networks are distinct and defined by the
switching system on which they are based. Wireless and
wireline infrastructures are largely separate. Those
communication networks which incorporate aspects of both
10 wireless and wireline networks often face difficult
switching choices. In such communication networks, switch
centric dependencies are evident. What is needed to
create a truly integrated wireless/wireline network is a
topology that supports a generic infrastructure
independent of switching and access technologies. Such
infrastructures presently do not exist. Classical
wireline and wireless operators are currently merging.
However, without a smooth switching infrastructure in
place, such systems are largely expensive and inefficient
to operate.

25 Another problem encountered in such communication
networks is the inability of such networks to support a
variety of air/wire access standards. Typically, a
communications network relies on one air/wire access
standard. In order to support a variety of air/wire
access standards, a combined wireline/wireless
infrastructure having the ability to support multiple
standards is needed. By solving these problems, which to
date have not been adequately addressed in the
30 communication networking arts, an integrated wireless and
wireline access infrastructure would be achieved, which

would be advantageous to both consumers and operators of communication networks. Such communication networks are also faced with an explosion in the demand for bandwidth in both wireline and wireless marketplaces. Fiber optic and coaxial-based technologies, in association with broadband wireless access technologies are emerging. However, present wireless and wireline infrastructures simply are incapable of supporting this bandwidth demand without major reconstruction.

Additionally, asynchronous transfer mode (ATM) has reached the critical point of acceptance. Asynchronous transfer mode is a communications protocol that promotes the transmission of voice, data, image, and video signals over wide-area high-bandwidth communications systems. ATM typically provides fast packet switching in which information is inserted in small, fixed-size cells (32 to 130 octets) that are multiplexed and switched in a slotted operation, based upon header content, over a virtual circuit established upon request for service. Investment in the construction of ATM networks is growing rapidly. Many of the largest wireline and wireline customers in existence have large and growing ATM networks. Integration of their wireless/wireline networks into their ATM fabric (physical structure of the network where generally, physical/logical communications channels connect port-to-port seamlessly) is simply a natural progression of present trends. However, without an efficient wireless/wireline access infrastructure available, even ATM networks are limited in their expansion. With an efficient/wireless access infrastructure available, ATM networks could expand even further.

Based on the foregoing, it can be appreciated that a need exists for a functional topology for integrated wireless/wireline networks. Such a need is met by the invention described herein.

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SUMMARY OF THE INVENTION

It is therefore one object of the present invention to provide an improved communications system.

5 It is therefore another object of the present invention to provide an improved communications system in which wireless and wireline communication devices can be utilized to initiate communication transactions.

10 It is yet another object of the present invention to provide an improved communications system in which wireless and wireline features are fully integrated with the communications system via an ATM infrastructure.

15 The above and other objects are achieved as is now described. A method and system for efficiently integrating wireless and wireline functions utilizing an ATM infrastructure within a communications network. The ATM infrastructure is composed of an ATM fabric and an ATM gateway. Wireless and wireline data are linked to the communications network via the ATM infrastructure, such that all wireless and wireline data transactions within the communications network are processed independently of any switching devices present within the communications network. Wireless and wireline data is transmitted to and from the communications network via a network access
25 function that allows wireless and wireline data to flow to and from the communications network. The wireless and wireline data is consolidated within the network access function in response to transmittal of the wireless and wireline data to the network access function. The
30 wireless and wireline data is transferred to the ATM

infrastructure from the network access function, in response to consolidating the wireless and wireline data within the network access function.

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BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of this invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objects, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 depicts a block diagram of a cellular telephone system in which a preferred embodiment of the present invention can be implemented;

Figure 2 illustrates a block diagram of a functional topology for an integrated wireless/wireline network, in accordance with a preferred embodiment of the present invention;

Figure 3 depicts a pictorial representation of a communications network in accordance with a preferred embodiment of the present invention ;

Figure 4 illustrates a high-level block diagram of an ATM Gateway in accordance with a preferred embodiment of the present invention ; and

Figure 5 illustrates a high-level flow chart of a method for implementing a functional topology in a communications network for an integrated wireless/wireline network, in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

With reference now to the figures and in particular with reference to **Figure 1**, a block diagram of a cellular telephone system 100 in which a preferred embodiment of the present invention may be implemented is depicted. The cellular telephone system 100 depicted in **Figure 1** includes a telephone company phone system (TELCO) 102, connected by telephone landlines to a control terminal 104 which in turn is coupled, also by telephone landlines, to a cellular base station 106 located in a cell of a mobile cellular telephone system. Those skilled in the art will appreciate that cellular telephone system 100 is one type of a communications system which may be utilized in accordance with a preferred embodiment of the present invention. For example, non-cellular, wireline and other such implemented telephone systems may be utilized in accordance with a preferred embodiment of the present invention. Cellular telephone system 100 as described herein is presented for illustrative purposes only.

Cellular telephone 108 communicates with cellular base station 106 via antennas 110 and 112. Antennas 110 and 112 can be implemented as telescopic whip antennas that extend or retract (i.e., lengthen or shorten), by being constructed in the form of overlapping concentric cylinders that slide inside of each other and make electrical contact with each other. It will be appreciated by those skilled in the art that such antennas are, of course, only examples of antennas that can be utilized with a cellular telephone system such as cellular telephone system 100. A wide variety of other antennae can also be utilized in conjunction with a wireless communication system such as cellular telephone system

100. Also, landlines utilized in association with cellular telephone system 100 are lines that can be placed in areas on land or inland waterways, and can include twisted-pair lines, coaxial cables, and fiber optic cables utilized in overhead, direct buried, underground, microwave, and satellite applications.

Additional cellular base stations may be located throughout a geographic area to provide telephone service to cellular telephones 108. Cellular base station 106 incorporates both a receiver antenna 112 and a transmitter antenna 114 for communicating with cellular telephones 108. Cellular telephone 108 may be a mobile-unit installed in a vehicle, a transportable unit which is a mobile-unit and battery installed in a carrying case, or a hand-held portable unit. Cellular telephone 108 includes an antenna 112 for the cellular radio channels. Those skilled in the art will recognize that cellular communications may be accomplished by means other than a handheld cellular telephone including automobile mounted cellular telephones, wireless modems and the like.

In the United States, cellular communications take place utilizing at least three different frequency modulation schemes including Time Division Multiple Access (TDMA), Call Division Multiple Access (CDMA) and Global System for Mobile communications (GSM). A cellular telephone operating with CDMA cannot generally access a TDMA or a GSM telephone without extensive modulation conversion. All of the above modulation schemes can be utilized in accordance with a preferred embodiment of the present invention.

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Figure 2 illustrates a block diagram of a functional topology for an integrated wireless/wireline network, in accordance with a preferred embodiment of the present invention. The topology outlined in Figure 2 includes specific functional entities. Voice Services Function 202, which is a centralized network resource that provides voice processing functions, including announcements, bridges, voice recognition/authentication, and advanced services support. Voice Services Function 202 is linked to ATM fabric 216, which underlies ATM Gateway 214. By constructing the network out of broadband/ATM components, the network is capable of flexibly carrying payloads ranging from narrowband voice/data to broadband multimedia data. The topology depicted in Figure 2, includes an Element Manager Function 204, also connected to ATM fabric 216, that provides operations, administration, maintenance, and provisioning functions for the network. The element management architecture facilitates real-time management of resources required for call processing.

The topology outlined in Figure 2 additionally includes a Call Processing Function 206, which provides service logic for supporting calls to and from the ATM fabric. Multiple call processing servers can exist in a given network. In Figure 2, for example, an additional call process function (i.e., Call Process Function 208) is also depicted. The topology outlined in Figure 2 also includes a Mobility Manager Function 210, connected to ATM Fabric 216. Mobility Manager Function 206 provides HLR/VLR access as well as IS-41 messaging links. The acronym "HLR" represents the term "Home Location Register," a defined network entity. The HLR is a database of local subscriber data, including provisioning, service, and

location information. The acronym VLR represents the term "Visitor's Location Register," which is also a defined network entity. The VLR is the location register other than the HLR, which is utilized by an MSC (i.e., Mobile Switching Center) to retrieve information for handling calls to or from a visiting subscriber. An example of an MSC is depicted in **Figure 3** as MSC 307. IS-41 messaging links are based on protocols outlined in the Electronic Industries Association/Telecommunications Industry Association (EIA/TIA) Standard IS-41 document (also referred to sometimes as "ANSI-41").

5 The topology depicted in **Figure 2** additionally includes
a Network Access Function 220 that consolidates traffic to
and from access devices (e.g., base transceiver stations,
digital loop carriers, and so forth), and interfaces these
access devices with ATM Fabric 216. Other primary
functions associated with Network Access Function 220
include signal processing, hand-off control, speech
processing, data/voice interworking, and access to
wireline communications networks (Public Switched
Telephone Network (PSTN) and Public Data Network (PDN)).
The communications network is inherently capable of
supporting either wireless or wireline services (or both).
Various access interface standards can be adapted at the
edge of the network via Network Access Function 220, which
is generally referred to as "NAF". Consequently, the
infrastructure is capable of supporting any or all access
standards, either alternatively or concurrently, which
promotes the mixing of wireless and wireline access as
well as incorporating multiple wireless and wireline
standards.

Access technology is adapted to the communications network at Network Access Function 220. The architecture outlined in **Figure 2** optimally addresses several primary challenges, including the ability to fully integrate wireless and wireline access infrastructures, while providing a generic infrastructure capable of supporting various wireless/wireline access standards. In addition, the structure depicted in **Figure 2** provides the ability to carry variable bandwidth multimedia payloads efficiently. By definition, the structure outlined in **Figure 2** applies to both fixed and mobile applications. Those skilled in the art will appreciate that mobility is flexible, and is chiefly a function of the type of access and the service being provided.

sub 24 Referring to **Figure 3**, a pictorial representation of a communications network in accordance with a preferred embodiment of the present invention is depicted. System 300 consists of multiple edge switches 301 that provide connection to ATM fabric 302 (see **Figure 2** for details). Various cellular frequency modulation schemes (TDMA, CDMA and GSM) are connected to ATM fabric 302 via edge switches 301. Multimedia-broadband data 304 may be transmitted to and from ATM fabric 302 via edge switch 301. Satellite 306 high speed transmission may be connected to the ATM fabric through edge switch 301 for transmission to households, cellular devices, etc. Local Multipoint Distribution System (LDMS) 309 is a method of distributing TV signals to households in a local area. In addition to receiving or transmitting TV signals via edge switch 301, LMDS is capable of handling voice and high speed data. Narrowband voice/data 310 is used to provide services such as paging, voice paging wireless data services.

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Referring to **Figure 4**, a high-level block diagram of an ATM Gateway in accordance with a preferred embodiment of the present invention, is illustrated. ATM Gateway 400 is comprised of an edge switch with multiple functions integrated into the switch. Call Processing (CP) 402 provides the logic to process and direct incoming signals to the various Gateway functions. Access Interface Function (AIF) 404, Interworking Function (IWF) 406, Voice Processing Function (VPF) 408, is a centralized network resource that provides voice processing functions including bridges, announcements, voice recognition and authentication, and advanced services support. Signal Processing Function (SPF) 410, provides the logic and necessary conversion functions for converting incoming and outgoing signals. Digital Service Level Zero (DS-0) Function (DSF) 412, is utilized to digitize voice transmission using pulse code modulation. Element Management Function (EMF) 414, connected to the ATM fabric, provides operation, administration, maintenance and provisioning functions for the network. Asynchronous Transfer Mode Interface function (ATM) 416, provides the interface for the ATM fabric. Trunk interface function (TIF) 418, provides an interface between the ATM fabric, the edge switch and wireline circuits thus, integrating wireline and wireless communication networks.

Referring now to **Figure 5**, a high-level flow chart of a method for implementing a functional topology in a communications network for an integrated wireless/wireline network, in accordance with a preferred embodiment of the present invention, is depicted. The process begins with step 500, which depicts a wireless phone going offhook. In this illustration a GSM wireless telephone is the

sub 2^b transmitting device and the target receiving device may be a cellular telephone that utilizes CDMA or TDMA. The devices may also be wireless, or wireline, modems. The process proceeds to step 502, which illustrates a Base Station Controller (BSC) receiving the off hook signal. The BSC manages resources in GSM and includes Base Transceiver station. The process then passes to step 504, which depicts the signal received by the BSC being sent to an edge switch interface (in the present invention, BSC functions are integrated into the edge switch). The process continues to step 506, which illustrates the signal being passed to the ATM Gateway (see Figure 6).

Next, the process passes to step 508, which depicts the Call Processing function being initiated upon receiving the signal. The call processing function provides service logic for supporting calls (note that multiple call processing serves can exist in a given communications network) and directs the incoming signal to the appropriate "translating" device contained within the edge switch. The signal, if necessary is converted to the target receiver protocol. The process then proceeds to step 510, which illustrates a determination of whether the target receiver is on the same BSC. If the target receiver is on the same BSC as the originating telephone, the process passes to step 512, which depicts the signal being routed to the APF (DEFINE) within the ATM Gateway. The process then moves to step 524, which illustrates the signal being transmitted by the BSC to the target receiver.

Returning to step 510, if the target receiver is not on the same BSC as the originating device the process passes

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instead to step 514, which illustrates the signal being passed to the ATM interface. The process then proceeds to step 516, which depicts the signal interfacing with the ATM fabric. The signal is transmitted on the ATM fabric to an edge switch that services the target device. The process continues to step 518, which illustrates the signal being received by the target edge switch (which is also an edge switch with an ATM gateway). The process then passes to step 520, which depicts the Call Processing function. The Call Processing function directs the signal to the proper protocol "translating" device, if necessary. The process then proceeds to step 522, which illustrates the proper device converting the signal to the receiver's protocol. Next the process passes to step 524, which depicts the converted signal transmitted to the target receiver.

The ATM Gateway contains multiple conversion devices as defined in **Figure 4**. The Call Processing function routes an incoming signal to a device that converts the incoming signal to an outgoing signal that is compatible with a targeted receiver. The Gateway queries the targeted receiver and determines the necessary conversion to make to communicate with the receiver and routes the signal through a converter before actual transmission.

The process described in **Figure 5** integrates wireless and wireline infrastructures utilizing an ATM infrastructure integrated with a communications network. The process also provides an infrastructure capable of supporting various air/wire access standards, and additionally provides the ability to carry variable bandwidth multimedia payloads efficiently. Those skilled

in the art will appreciate that the process depicted in **Figure 5** is also applicable to both fixed and mobile applications.

5 It can be appreciated by those skilled in the art that **Figure 5** presents a sequence of steps leading to a desired result. The steps generally require manipulation of physical quantities. Usually, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise
10 manipulated. It has proven convenient at times by those skilled in the art, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities.

Further, the manipulations performed are often referred to in terms, such as "linking," "transmitting," "designating," or "transferring", which are commonly
20 associated with mental operations performed by a human operator. No such capability of a human operator is necessary or desirable in most cases in any of the operations described herein which form part of the present invention because the operations are machine operations.
25 Useful machines for performing operations of a preferred embodiment of the present invention include data-processing systems such as general purpose digital computers or other similar devices. In all cases the distinction between the method operations in operating a
30 computer and the method of computation itself should be borne in mind.

5 The present invention relates to method steps for processing electrical signals can be implemented via a computer. Such instructions can be maintained with a computer memory at a cellular telephone base station or a central broadcasting center from which such base stations receive instructions. Implementation of the method described herein is left to the discretion of a particular cellular telephone system designer.

10 It can be appreciated by one skilled in the art that the methods or processes described herein can be implemented as a program product, such as a control program residing within a computer memory and containing instructions that when executed, will carry out the operations depicted in the logic flow charts described herein. It is important to note that, while the present invention can be described in the context of a fully functional computer system, those skilled in the art can appreciate that the present invention is capable of being distributed as a program product in a variety of forms, and that the present invention applies equally, regardless of the particular type of signal-bearing media utilized to actually carry out the distribution. Examples of signal-bearing media include: recordable-type media, such as floppy disks, hard-disk drives and CD ROMs, and
25 transmission-type media, such as digital and analog communication links.

30 Preferred implementations of the invention can include implementations to execute the method or methods described herein as a computer program product residing in a memory of microcomputer. Alternatively, a preferred embodiment of the present invention can include a program product

residing in a microcomputer memory located at an MSC
(i.e., "MSC" is an acronym for "mobile switching center").
An MSC typically controls system operations in cellular
networks. For example, an MSC can control calls, track
5 billing information, and locate cellular subscribers. The
program product thus includes sets of instructions for
executing the method and systems described herein. Until
required by the microcomputer, the set of instructions may
be stored as a computer-program product in another
10 computer memory, for example, in a disk drive attached to
the microcomputer (which may include a removable memory
such as an optical disk or floppy disk for eventual use in
the disk drive).

Further, the computer-program product can also be
stored at another computer and transmitted when desired to
the user's workstation by a network or by an external
network. One skilled in the art can appreciate that the
physical storage of the sets of instructions changes the
medium upon which it is stored so that the medium carries
computer-readable information. The change may be
electrical, magnetic, or some other change. While it is
convenient to describe the invention in terms of
instructions, symbols, characters, or the like, the reader
should remember that all of these and similar terms should
25 be associated with the appropriate physical elements.

The embodiments and examples set forth herein are
presented in order to best explain the present invention
and its practical application and to thereby enable those
skilled in the art to make and utilize the invention.
30 However, those skilled in the art will recognize that the
foregoing description and examples have been presented for

the purposes of illustration and example only. The description as set forth is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching without departing from the spirit and scope of the following claims.

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